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A SHEAF OF NATURE NOTES

BY JOHN BURROUGHS

I

NATURE'S WIRELESS

THE Spirit of the Hive, which Maeterlinck makes so much of, seems to give us the key to the psychic life of all the lower orders. What one knows, all of that kind seem to know at the same instant. It seems as if they draw it in with the air they breathe. It is something like community of mind, or unity of mind. Of course it is not an intellectual process, but an emotional process; not a thought, as with us, but an impulse.

So far as we know there is nothing like a council or advisory board in the hive. There are no decrees or orders. The swarm is a unit. The members act in concert without direction or rule. If anything happens to the queen, if she is lost or killed, every bee in the hive seems to know it at the same instant, and the whole swarm becomes greatly agitated. The division of labor in the hive is spontaneous, the bees function and coöperate as do the organs in our own bodies, each playing its part without scheme or direction.

This community of mind is seen in such an instance as that of the migrating lemmings from the Scandinavian peninsula. Vast hordes of these little creatures are at times seized with an impulse to migrate or to commit suicide, for it amounts to that. They leave their *habitat* in Norway and without being deflected by any obstacle, march straight towards the sea, swimming lakes and rivers that lie in their way. When the coast is reached, they enter the water and continue on their course. Ship captains

report sailing for hours through waters literally alive with them. This suicidal act of the lemmings strikes one as a kind of insanity. It is one of the most puzzling phenomena I know of in animal life. But the migration of all animals on a large scale shows the same unity of purpose. The whole tribe shares in a single impulse. The animal migration of the caribou in the North is an illustration. In the flocking birds this unity of mind is especially noticeable. The vast armies of passenger pigeons which we of an older generation saw in our youth, moved like human armies under orders. They formed a unit. They came in countless hordes like an army of invasion, and they departed in the same way. Their orders were written upon the air; their leaders were as intangible as the shadows of their wings. The same is true of all our flocking birds; a flock of snow buntings, or of starlings, or of blackbirds, will act as one body, performing their evolutions in the air with astonishing precision.

In Florida, in the spring when the mating instinct is strong, I have seen a flock of white curlews waltzing about the sky, going through various intricate movements, with the precision of dancers in a ball-room quadrille. No sign, no signal, no guidance whatever. Let a body of men try it under the same conditions, and behold the confusion, and the tumbling over one another! At one moment the birds would wheel so as to bring their backs in shadow, and then would flash out the white of their breasts and under parts. It was like the opening and shutting of a giant hand, or the alternate rapid darkening and brightening of the sail of a tacking ice-boat. This is the spirit of the flock. When a hawk pursues a bird, the birds tack and turn as if linked together. When one robin dashes off in hot pursuit of another, behold how their movements exactly coincide! The hawk-hunted bird often escapes by reaching the cover of a tree or a bush, but not by dodging its pursuer, as a rabbit or a squirrel will dodge a dog. Schools of fish act with the same machine-like unity.

In the South I have seen a large area of water, acres in extent, uniformly agitated by a school of mullets apparently feeding upon some infusoria on the surface, and then instantly, as if upon a given signal, the fish would dive and the rippling cease. It showed a unity of action as of ten thousand spindles controlled by electricity.

How quickly the emotion of fear is communicated among the wild animals! How wild and alarmed the deer become after the opening of the first day of the shooting season. Those who have not seen or heard a hunter seem to feel the impending danger.

The great flocks of migrating butterflies (the monarch) illustrate the same law. In the fall they are all seized with this impulse to go South and thousands of them march in one body. At night they roost in the trees. I have seen photographs of them in which they appeared like a new kind of colored foliage covering the trees. In the return flight in the spring, the same massing again occurs. Recently the Imperial Valley in California was invaded by a vast army of worms moving from east to west. In countries that have been cursed with a plague of grasshoppers witnesses of the spectacle describe them as moving in the same way. They stopped or delayed railway trains and automobiles—their crushed bodies making the rails and highways as slippery as grease would have made them. Ten million or ten billion behaving as one.

This community of mind stands the lower orders in great stead. It makes up to them in a measure for the want of reason and judgment. In what we call telepathy we get hints of the same thing among ourselves. Telepathy is probably a survival from our earlier animal state.

II

MAETERLINCK ON THE BEE

Maeterlinck in his *Life of the Bee* resists the conclusion of Sir John Lubbock that flies are more intelligent than honey bees:

"If you place in a bottle half a dozen bees," says Sir John, "and the same number of flies, and lay the bottle down horizontally with its base to the window, you will find that the bees will persist till they die of exhaustion or hunger in their endeavors to discover an issue through the glass; while the flies, in less than two minutes, will all have sallied forth through the neck on the opposite side."

The flies are more intelligent than the bees because their problems of life are much more complicated; they are fraught with many more dangers; their enemies lurk on all sides; while the bees have very few natural enemies.

There are no bee catchers in the sense that there are scores of fly catchers. I know of no bird that preys upon the worker bees. The kingbird is sometimes called the "bee martin" because he occasionally snaps up the drones. All our insectivorous birds prey upon the flies; the swallows sweep them up in the air, the swifts scoop them in, while, besides the so-called fly-catchers, the cedar birds, the thrushes, the vireos, and all other soft-billed birds, subsist more or less upon them. Try to catch a big blow-fly upon the window-pane and see how difficult the trick is, while with a honey bee it is no trick at all. Or try to swat the ordinary house-fly with your hand. See how he squares himself and plants himself as your threatening hand approaches! He is ready for a trial of speed. He seems to know that your hand is slower than he is, and he is right in most cases. Now try a honey bee. The case is reversed. The bee has never been stalked; it shows no fear; and to crush it is as easy as to crush a beetle.

The wit and cunning of all animals are developed by their struggle for existence. The harder the struggle, the more their intelligence. Our skunk and porcupine are very stupid because they do not have to take thought about their own safety; Nature has done that for them.

To bolster up his case, Maeterlinck urges that "the capacity for folly so great in itself argues intelligence," which amounts to saying that the more fool you are, the more you know.

Buffon did not share Maeterlinck's high opinion of the intelligence of the bee; he thought the dog, the monkey, and the majority of other animals, possess far more; an opinion which I share. Indeed, of free intelligence the bee possesses very little. He is the slave of an overmastering instinct, as our new nature poet, McCarthy, says,

She makes of labor an eternal lust.

Bees do wonderful things, but do them blindly. They work as well (or better) in the darkness as in the light. The Spirit of the Hive knows and directs all. The unit is the swarm, and not the individual bee.

The bee does not know fear; she does not know love. She will defend the swarm with her life, but her fellows she heeds not.

It is very doubtful if the individual bees of the same

hive recognize one another at all outside the hive. Every bee-hunter knows how the bees from the same tree will clip and strike at one another around his box, when they are first attracted to it. After they are seriously engaged in carrying away his honey, they pay no attention to one another or to bees from other swarms. That bees tell one another of the store of honey they have found is absurd. The unity of the swarm attends to that.

Maeterlinck tells of a little Italian bee that he once experimented upon during an afternoon, the results showing that this bee had told the news of her find to eighteen bees! Its "vocabulary" stood it in good stead!

Maeterlinck's conception of the Spirit of the Hive was an inspiration, and furnishes us with the key to all that happens in the hive. The secret of all of its economies are in the phrase. Having hit upon this solution, he should have had the courage to stand by it. But he did not. He is continually forgetting it and applying to his problem the explanations we apply in our dealings with one another. He talks of the power of the bees to give "expression to their thoughts and feelings;" of their "vocabulary," phonetic and tactile; he says that the "extraordinary also has a name and place in their language;" that they are able to "communicate to each other news of an event occurring outside the hive;" all of which renders his Spirit of the Hive superfluous. He quotes from a French apiarist who says that the explorer of the dawn—the early bee,—like the early bird that catches the worm, returns to the hive with the news that "the lime trees are blooming today on the banks of the canal;" "the grass by the roadside is gay with white clover;" "the sage and the lotus are about to open;" "the mignonette and the lilies are overflowing with pollen." "Whereupon the bees must organize quickly and arrange to divide the work." They probably call a council of the wise ones and after due discussion and formalities proceed to send out their working expeditions. "Five thousand of the sturdiest will sally forth to the lime trees, while three thousand juniors go and refresh the white clover." "They make daily calculations as to the means of obtaining the greatest possible wealth of saccharine liquid."

When Maeterlinck speaks of "the hidden genius of the hive issuing its commands," or recognizes the existence among the bees of spiritual communications that go beyond

a mere "yes" or "no," he is true to his own conception.

The division of labor among hive bees is of course spontaneous, like all their other economies—not a matter of thought, but of instinct.

Maeterlinck and other students of the honey bee make the mistake of humanizing the bee, thus making them communicate with one another as we communicate. Bees have a language, they say; they tell one another this and that; if one finds honey or good pasturage, she tells her sisters, and so on. This is all wide of the mark. There is nothing analogous to verbal communication among the insects. The unity of the swarm, or the Spirit of the Hive, does it all. Bees communicate and coöperate with one another as the cells of the body communicate and cooperate in building up the various organs. The spirit of the body coördinates all the different organs and tissues, making a unit of the body.

If some outside creature, such as a mouse or a snail, penetrates into the hive, and dies there, the bees encase it in wax, or bury it where it lies, so that it cannot contaminate the hive, and a foreign object in the body, such as a bullet in the lungs, or in the muscles, becomes encysted in an analogous manner, and is thus rendered harmless.

Kill a bee in or near the hive and the smell of its crushed body will infuriate the other bees. But crush a bee in the fields or by the bee-hunter's box which is swarming with bees, and the units from the same hive heed it not.

Bees have no fear. They have no love or attachment for one another as animals have. If one of their number is wounded or disabled, they ruthlessly expel it from the hive. In fact, they belong to another world of beings that is absolutely oblivious of the world of which we form a part. They murder or expel the drones, after they have done their work of fertilizing the queen, in the most cruel and summary manner. Their apparent attachment to the queen, and their loyalty to her, are not personal. They do not love her. It is the Spirit of the Hive, or the cult of the swarm solicitous about itself. There are no brothers, sisters, fathers, mothers, among the bees; there are only co-workers, working not for the present, but for the future. When we enter the kingdom of the bee, we must leave all our human standards behind. These little people have no red blood, no organs of sense, as we have, they breathe and hear through their legs, their antennae.

The drones do not know the queen as such in the hive. Their instincts lead them to search for her in the air during her nuptial flight, and they know her only there. The drones have thirteen thousand eyes, while the workers have only six thousand. This double measure of the power of vision is evidently to make sure that the males discover the queen in her course through the air.

The guards that take their stand at the gate, the bees that become fans at the entrance to ventilate the hive, the nurses, the bees that bring the bee bread, the bees that pack it into the cells, the bees that go forth to find a home for the new swarm, the sweepers and cleaners of the hive, the workers that bring *propolis* to seal up the cracks and crevices—all act in obedience to the voiceless Spirit of the Hive.

After we have discounted Maeterlinck so far as the facts will bear us out in doing, it remains to be said that he is the philosopher of the insect world. If Fabre is the Homer, as he himself has said, Maeterlinck is the Plato of that realm. How wisely he speaks of the Insect World in his latest volume, *Mountain Paths*:

“The insect does not belong to our world. The other animals, the plants even, notwithstanding their dumb life and the great secrets which they cherish, do not seem wholly foreign to us. In spite of all, we feel a certain earthly brotherhood with them. They often surprise and amaze our intelligence, but do not utterly upset it. There is something, on the other hand, about the insect that does not belong to the habits, the ethics, the psychology of our globe. One would be inclined to say that the insect comes from another planet, more monstrous, more energetic, more insane, more atrocious, more infernal than our own. One would think that it was born of some comet that had lost its course and died demented in space.”

Speaking of the intelligence of bees reminds me of a well-known woodsman and camp-fire man who recently extolled in print the intelligence of hornets, saying that they have the ability to differentiate friends from foes. “They know us and we talk to them and they are made to feel as welcome as any of our guests.” “When a stranger visits the camp, they attract the attention of one they know *who recognizes their signal by thought or gesture and leaves immediately, returning only when the stranger has departed.*” (The italics are mine.) He says the same hornets

apparently come to them year after year, greeting them on their arrival, and should they be accompanied by strangers, they treat them with the same deference as "when they visit us after we have been in camp some time."

Did one ever hear before of such well-bred and well-mannered bees? What would Maeterlinck say to all that? Its absurdity becomes apparent when we remember that hornets live but a single season, that none of them lives over the winter, save the queen, and that she never leaves the nest in summer after she has got her family of workers around her.

III

ODD OR EVEN

One of our seven wise men once said to me, "Have you observed that in the inorganic world things go by even numbers? And in the organic world by odd?" I immediately went down to the edge of a bushy and swampy meadow below our camp and brought him a four-petalled flower of galium, and a plant-stalk with four leaves in a whorl. In another locality I might have brought him dwarf cornel, or the *Housotonia*, or wood sorrel, or the evening primrose. Yet even numbers are certainly more suggestive of mechanics than of life, while odd numbers seem to go more with the freedom and irregularity of growing things.

One may make pretty positive assertions about non-living things. Crystals, so far as I know, are all even-sided, some are six and some eight-sided; snowflakes are of an infinite variety of pattern but the number six rules them. In the world of living things we cannot be so sure of ourselves. Life introduces something indeterminate and incommensurable. It makes use of both odd and even, though undoubtedly odd numbers generally prevail. Leaves that are in lobes usually have three or five lobes. But the stems of the mints are four square, and the cells of the honey bee are six-sided. We have five fingers and five toes, though only four limbs. Locomotion is mechanical and even numbers serve better than odd. Hence the six-legged insects. In the inorganic world things attain a stable equilibrium, but in the living world the equilibrium is never stable. Things are not stereotyped, hence the danger of dogmatizing about living things. Growing Nature will not be driven into a corner.

Well may Emerson ask—

Why Nature loves the number five,
And why the star form she repeats?

The number five rules in all the largest floral families, as in the Crowfoot family, the Rose family (which embraces all our fruit trees), the Geranium family, the Flax family, the Campanula family, the Convolvulus family, the Nightshade family. Then there is a large number of flowers, the parts of which go in threes, one of the best known of which is the trillium. In animal life the star fish is the only form I recall based on the number five.

IV

WHY AND HOW

One may always expect in living nature variations and modifications. It is useless to ask "Why". Nature is silent when interrogated in this way. Ask her "How", and you get some results. If we ask, for instance, why the stinger of the honey bee is barbed, and those of the hornet and wasp and bumble bee, and of other wild bees, are smooth like a needle, so that they can sting and sting again, and live to sting another day, while the honey bee stings once at the cost of its life; or why only one species of fish can fly; or why one kind of eel has a powerful electric battery; or why the porcupine has an armor of quills while his brother rodent, the woodchuck, has only fur and hair, and so on, we make no addition to our knowledge.

But if we ask, for instance, how so timid and defenseless an animal as the rabbit manages to survive and multiply, we extend our knowledge of natural history. The rabbit prospers by reason of its wakefulness—by never closing its eyes, and by its speed; also by making its home where it can command all approaches, and so flee in any direction. Or if we ask how our ruffed grouse survives and prospers in a climate where its cousin, the quail, perishes, we learn that it eats the buds of certain trees, while the quail is a ground feeder and is often cut off by a deep fall of snow.

If we ask why the chipmunk hibernates, we get no answer; but if we ask how he does it, we find out that he stores up food in his den, hence must take a lunch between his naps. The woodchuck hibernates, also, but he stores up fuel in the shape of fat in his own body. The porcupine is

above ground and active all winter. He survives by gnawing the bark of certain trees, probably the hemlock. We have two species of native mice that look much alike, the white-footed mouse, and the jumping, or kangaroo mouse. The white-foot is active the season through, over and under the snow; the jumper hibernates all winter, and apparently accomplishes the feat by the power he has of barely keeping the spark of life burning. Its fires are banked, so to speak; its temperature is very low, and it breathes only at long intervals.

If, then, we ask with Emerson, "*why* Nature loves the number five," and "*why* the star form she repeats," we shall be put to it for an answer. We can only say that with living things odd numbers are more likely to prevail, and with non-living, even numbers.

Some seeds have wings and some have not. To ask why, is a blind question, but if we ask *how* the wingless seeds get sown, we may add to our knowledge.

In our own practical lives, in which experimentation plays such a part, we are often compelled to ask why this result, and not that? Why this thing behaves this way, and that thing that way? We are looking for reasons or causes. The farmer asks why his planting in this field was a failure, while it was a success in the next field, and so on. An analysis of his soil or of his fertilizer and culture will give him the answer.

V

AN INSOLUBLE PROBLEM

That Darwin was a great natural philosopher and a good and wise man admits of no question, but to us, at this distance, it seems strange enough that he should have thought that he had hit upon the key to the origin of species in the slow and insensible changes which he fancied species underwent during the course of the geologic ages, and should thus have used that phrase as the title of his book. Had he called his work the Variability of Species, or the Modification of Species, it would not have been such a misnomer. Sudden mutations give us new varieties, but not new species. In fact, of the origin of species we know absolutely nothing, no more than we do about the origin of life itself.

Of the development of species we know some of the factors that play a part, as the influence of environment, the

struggle for existence, and the competitions of life. But do we not have to assume an inherent tendency to development, an original impulse as the key to evolution? Accidental conditions and circumstances modify, but do not originate species. The fortuitous plays a part in retarding or hastening a species, and in its extinction, but not in its origin. The record of the rocks reveals to us the relation of species, and their succession in geologic time, but gives no hint of their origin.

Agassiz believed that every species of animal and plant was the result of a direct and separate act of the Creator. But the nationalist sees the creative energy imminent in matter. Does not one have to believe in something like this to account for the world as we see it? And to account for us also?—a universal mind or intelligence

Whose dwelling is the light of setting suns,
And the round ocean and the living air,
And the blue sky, and in the mind of man.

Agassiz was too direct and literal; he referred to the Infinite Mystery in terms of our own wills and acts. When we think of a Creator, and of a thing created as two, we are in trouble at once. They are one, as fire and light are one, as soul and body are one. Darwin said he could not look upon the world as the result of chance, and yet his theory of the origin of species ushers us into a chance world. But when he said, speaking of the infinite variety of living forms about us, that they "have all been produced by laws acting around us," he spoke as a great philosopher. But these laws are not fortuitous, or the result of the blind grouping of irrational forces.

VI

A LIVE WORLD

It was "the divine Kepler," as Professor Shaler calls him, who looked upon the earth as animated in the fashion of an animal. "To him this world is so endowed with activities that it is to be accounted alive." But his critics looked upon this fancy of Kepler's as proof of a disordered mind.

Now I read in a work of George Darwin's (son of the great naturalist), on the Tides, that the earth in many ways behaves more like a living organism than like a rigid insensate sphere. Its surface throbs and palpitates and quivers and yields to pressure as only living organisms do. The

tides can hardly be regarded as evidences of its breathing, as Kepler thought they could, but they are proof of how closely it is held in the clasp of the heavenly forces. It is like an apple on the vast siderial tree, that has mellowed and ripened with age. Our moon is no doubt as dead as matter can be. It is hard to fancy its surface yielding to our tread as does that of the earth. Then we know that the absence of air and water on it is proof that it cannot be endowed with what we call life. George Darwin tells us that when we walk on the ground we warp and bend the surface very much as we might bend or dent the epidermis of a colossal pachyderm. He and his brother devised an instrument by which the slight fluctuations of the ground, as we move over it, could be measured. The instrument was so delicate that it revealed the difference of effect produced by the same pressure at seven feet and at six feet from the instrument! More than that, the instrument revealed the throbbing and agitations which the ground is undergoing at all times. They found that minute earthquakes, or microseisms, as the Italians call them, are occurring constantly.

Another instrument has been invented called the microphone, which translates this earth's movements into sound—its tremors and agitations become audible. This microphone when placed in a cave twenty feet below the surface, and carefully protected by means of a carpet from any accidental disturbance in its immediate vicinity, revealed what is called "natural telluric phenomena; such as roarings, explosions, occurring isolated or in volleys, and metallic or bell-like sounds." "The noises sometimes become intolerably loud," especially on one occasion in the middle of the night, half an hour before a sensible earthquake."

Our apparently impassive and slumbering old planet evidently has dreams we know little of.

From Professor Shaler's *Nature and Man in America* I get an impression which again deepens my feeling of something half human about our lucky planet, at least something progressive and unequal, like life itself. Shaler finds that organic development in the northern hemisphere is more advanced by a whole geologic period, than in the southern; with Europe at the head and Australia the greatest laggard. The animal life of Australia is much like that of Europe in the Jurassic period, while both Asia and

Africa possess forms, such as elephants, and tigers, and lions, which abounded in Europe in Tertiary times. Hence the Northern hemisphere is more like the head of the beast, and the Southern more like the viscera. The northern races easily dominate the southern. The flowering of civilization is in the north. It is very certain that man originated north of the equator. I think that one need not expect that the achievements of man in Australia, or in South America, will rival the achievements of man nearer the magnetic pole of the earth.

VII

DARWINISM AND THE WAR

That Darwinism was indirectly one of the causes of the world war seems to me quite obvious. Unwittingly the great and gentle naturalist has more to answer for than he ever dreamed of. His biological doctrine of the struggle for existence, natural selection, and the survival of the fittest, fairly intoxicated the Germans from the first. These theories fell in well with their militarism and their natural cruelty and greediness. Their philosophers took them up eagerly. Weissmann fairly made a god of natural selection, as did other German thinkers. And when they were ready for war, the Germans at once applied the law of the jungle to human affairs. The great law of evolution, the triumph of the strong, the supremacy of the fit, became the foundation of their political and national ideals. They looked for no higher proof of the divinity of this law as applied to races and nations, than the fact that the organic world had reached its present stage of development through the operation of this law. Darwin had given currency to these ideals. He had denied that there was any inherent tendency to development, that we lived in a world of chance, and that power only comes to him who exerts power—half truths, all of them.

The Germans as a people have never been born again in to the light of our higher civilization. They are morally blind and politically treacherous. Their biological condition is that of the lower orders, and the Darwinian law of progress came to them as an inspiration. Darwin's mind, in its absence of the higher vision, was a German mind. In his plodding patience, his devotion to details, and in many other ways, his mind was

German. But in his candor, his truthfulness, his humility, his simplicity, he was anything but German. Undoubtedly his teachings bore fruit of a political and semi-political character in the Teutonic mind. The Teutons incorporated the law of the jungle in their ethical code. Had not they the same right to expansion and to the usurpation of the territory and to the treasures of their neighbors that every weed in the fields and even the vermin of the soil and the air have? If they had the sanction of natural law, that was enough; they were quite oblivious to the fact that with man's moral nature had come in a new biological law which Darwin was not called upon to reckon with, but which has tremendous authority and survival value—the law of right, justice, mercy, honor, love.

We do not look for the Golden Rule among swine and cattle, or among wolves and sharks; we look for it among men; we look for honor, for heroism, for self-sacrifice, among men. None of these things are involved in the Darwinian hypothesis. There is no such thing as right or wrong in the orders below man. These are purely human distinctions. It is not wrong for the wolf to eat the lamb, nor the lamb to eat the grass, but an aggressive war is wrong to the depths of the farthest star. Germany's assault upon the peace and prosperity of the world was a crime against the very heavens.

Darwin occupied himself only with the natural evolution of organic forms, and not with the evolution of human communities. He treated man as an animal, and fitted him into the zoological scheme. He removed him from the realm of the miraculous into the plane of the natural. For all purposes of biological discussion, man is an animal but that is not saying he is only an animal, and still under the law of animal evolution. The European man is supposed to have passed the stage of savagery, in which the only rule of right is the rule of might. To have made Darwinism an excuse for a war of aggression, is to have debased a sound natural philosophy to a selfish and ignoble end.

Germany lifted the law to the human realm and staked her all upon it, and failed. The moral sense of the world—the sense of justice, of fair play, was against her, and inevitably she went down. Her leaders were morally blind. When the rest of the world talked of moral standards, the German leaders said, "We think you are fools." But

these standards brought England into the war—the sacredness of treaties. It brought the United States in. We saw a common enemy in Germany, an enemy of mankind. We sent millions of men to France for an ideal—for justice and fair play. To see our standards of right and justice ignored and trampled upon in this way was intolerable. The thought of the world being swayed by Prussianism was unbearable. I said to myself from the first, “The Allies have got to win—there is no alternative.” And what astonishes me is that certain prominent Englishmen, such as Lord Morley, John Bright, and others, did not see it. Would they have sat still and watched Germany destroy France and plant herself upon the Channel and make ready to destroy England? The very frame-work of our moral civilization would have been destroyed. Darwin little dreamed to what his natural selection theory was to lead.

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